

REMARKS

The Examiner is thanked for the thorough examination of the application. A Declaration Under 37 C.F.R. §1.132 is appended to this paper. A substitute Abstract is provided that is within 50-150 words. Claims 1-5, 8, 9 and 12-18 are pending in the application. By this Amendment, claims 6, 7 and 10 are canceled and their subject matter is incorporated into claim 1, and the amendments to claim 1 find additional support at page 3, line 11 of the specification. Claim 9 has been amended to better set forth a process claim. Claims 12-18 are newly presented for the Examiner's consideration. No new matter is believed to be added.

Claim Objections

The Examiner objects to claim 3 as failing to further limit a previous claim. Claim 3 has been amended to further limit claim 1. Also, the claims have been amended to remove recitations of "stabilized" nitric acid. The Examiner is accordingly respectfully requested to withdraw the claim objections.

Rejection Under 35 U.S.C. §112, Second Paragraph

Claims 1, 3, 6, 8 and 10 have been rejected under 35 U.S.C. §112, second paragraph, as being indefinite. This rejection is respectfully traversed.

In the Office Action, the Examiner asserts that the term "stabilized" is unclear. However, the claims have been

amended such that properties of the nitric acid are better described, such that the utilization of the term "stabilized" is redundant. As a result, the claims are clear, definite and have full antecedent basis.

This rejection is overcome and withdrawal thereof is respectfully requested.

Rejections Under 35 U.S.C. §103(a)

Claims 1-9 have been rejected under 35 U.S.C. §103(a) as being unpatentable over GB 1,040,139. Claim 10 has been rejected under 35 U.S.C. §103(a) as being unpatentable over GB 1,040,139 in view of U.S. Patent 1,596,622 and U.S. Patent 2,294,849. These rejections are respectfully traversed for at least the reasons set forth below.

The present invention pertains to a novel process for producing a mononitrate compound of the formula (I):



where A is a C₂-C₆ alkylene chain. As is set forth, in part, in claim 1, this mononitrate is synthesized by nitrating a compound of formula (II):



wherein A is as defined above,
with nitric acid having a concentration ranging from 83 to 85%, and a concentration of nitrous acid and nitrogen oxides lower than 10 p.p.m., in a weight ratio of from 10:1 to 15:1

by weight with respect to compound (II), for a time ranging from 10 to 30 minutes.

GB 1,040,139 pertains to a method for producing a partially nitrated ester of an aliphatic monomeric alcohol containing up to 5 hydroxy groups, where the nitrating agent can be 60 to 85% nitric acid alone or in a 1:1 weight mixture with sulphuric acid. According to Examples 1 and 2 of GB 1,040,139, urea is added to nitric acid followed by the polyhydric alcohol and sulphuric acid. Suitable molar ratios between the nitrating agent and the alcohol range from about 4.88:1 to about 7.55:1, as reported in Examples 1-4. The problem of esterifying only some of the hydroxy groups has been addressed in GB 1,040,139 by utilizing a chlorinated hydrocarbon, which functions as a solvent for the partially nitrated ester that forms in the course of the reaction, but not for the starting monomeric alcohol, thus preventing further nitration.

GB 1,040,139 fails to disclose the utilization of compounds that are highly soluble in chlorinated hydrocarbons.

Unlike the polyols of GB 1,040,139, the compounds of formula (I) and (II) of the present invention are highly soluble in chlorinated hydrocarbons. One of ordinary skill in the art would therefore not expect, based on the teachings of GB 1,040,139, that in a chlorinated organic solvent an alkanediol like butanediol mononitrate (BDMN), for example,

would be further nitrated to butanediol dinitrate (BDDN), as actually occurs. One of ordinary skill in the art would therefore conclude that the technology of GB 1,040,139 is unsuitable for the synthesis of mononitration products, such as is set forth in claim 1 of the present invention.

As a result, a *prima facie* case of obviousness has thus not been made over GB 1,040,139 (or any combination using GB 1,040,139). Claims depending upon claim 1 are patentable for at least the above reasons.

Regarding claim 9, the Examiner asserts that claim 9 is a product-by-process claim having limited patentable weight. However, claim 9 has been amended to more clearly set forth a process claim.

Further, the present invention shows unexpected results over GB 1,040,139. Attached please find a Declaration Under 37 C.F.R. §1.132.

The attached Declaration presents the following experimental measurements in order to demonstrate the non-obviousness of claims of the application:

EXAMPLE A

Example 3 of GB 1,040,139 was repeated using butanediol (BD), instead of pentaerythritol, with the highest molar ratio of nitrating agent/substrate taught by GB 1,040,139, i.e., 7.55:1, instead of 6.70:1. After 10 minutes from the addition of

sulfuric acid, the reaction mixture decomposed with the production of nitrous vapors.

EXAMPLE B

Example 1 of GB 1,040,139 was repeated using BD instead of pentaerythritol, in the same molar ratio, i.e., 7.55:1, and with nitric acid as the nitrating agent. After 18 minutes, the reaction was quenched in water. Butanediol-mononitrate (BDMN) was obtained in a molar yield of about 14.7%, and butanediol-dinitrate (BDDN) was obtained in a molar yield of about 20.3% as a byproduct.

EXAMPLE C

Example B was repeated, and after 1 hour the reaction was quenched in water. BDMN was obtained in a molar yield of about 17.4%, and BDDN was obtained in a molar yield of 16.5% as a byproduct.

EXAMPLE D

Example C was repeated and the reaction was quenched in water after 2 hours. BDMN was obtained in a molar yield of about 19.9%, and BDDN was obtained in a molar yield of about 15.5% as a byproduct.

These results demonstrate that that the nitration of butanediol according to GB 1,040,139 will fail to achieve mononitration, because the reaction yields a considerable amount of dinitration product. In particular, these experiments demonstrate that:

- a mixture of nitric and sulfuric acid is not suitable for the mononitration of alkanediols, and it should be noted that even though GB 1,040,139 teaches that mononitration can be carried out using nitric acid alone or in admixture with sulfuric acid, all the examples entail the utilization of sulfuric acid;

- GB 1,040,139 teaches that the optimal period for the completion of the reaction is between 1 and 2 hours, while the process of the present invention is carried out for a time ranging from 10 to 30 minutes; and

- GB 1,040,139 teaches that the molar ratio between the nitrating agent and the substrate should range from 4.88:1 to 7.55:1, but Examples B and C demonstrate that this ratio will yield a considerable amount of dinitration product.

Accordingly, the effective mononitration of alkanediols is surprising and represents an unexpected result over GB 1,040,139. The present invention results from the inventive selection of several specific reaction conditions that lead to the mononitration of alkanediols of formula (II), namely:

- the lack of sulfuric acid in the nitrating agent;
- the concentration of nitrating nitric acid;
- the utilization of nitric acid substantially free from nitrous acid and nitrogen oxides;
- the weight ratio of nitric acid to the compound of formula (II); and

- the contact time between nitric acid and the compound of formula (II).

Therefore, any obviousness that may be alleged over GB 1,040,139 is fully rebutted by the unexpected results of the present invention.

These rejections are overcome and withdrawal thereof is respectfully requested.

Conclusion

The Examiner is thanked for considering the Information Disclosure Statement filed May 12, 2005, and for making the initialed PTO-1449 form of record in the application.

The prior art cited but not utilized by the Examiner indicates the status of the conventional art that the invention supercedes. Additional remarks are accordingly not necessary.

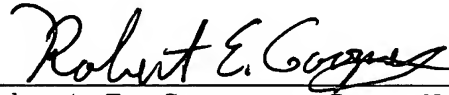
The Examiner's objections and rejections have been overcome, obviated or rendered moot. No issues remain. The Examiner is accordingly respectfully requested to place the application in condition for allowance and to issue a Notice of Allowability.

The Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment

to Deposit Account No. 25-0120 for any additional fees required
under 37 C.F.R. § 1.16 or under 37 C.F.R. § 1.17.

Respectfully submitted,

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APPENDIX:

The Appendix includes the following item(s):

- ☐ - a terminal disclaimer
- ☒ - a new or amended Abstract of the Disclosure
- ☒ - a 37 CFR 1.132 Declaration
- ☐ - a Replacement Sheet for Figure of the drawings
- ☐ - a Substitute Specification and a marked-up copy of the
originally-filed specification
- ☐ - a verified English translation of foreign priority document